PATENT APPLICATION

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# PATIENT POINT OF CARE COMPUTER SYSTEM

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# PATIENT POINT OF CARE COMPUTER SYSTEM

This application claims the benefit of U.S. provisional application Serial No. 60/202,283 filed May 5, 2000 and U.S. provisional application Serial No. 60/229,136 filed August 30, 2000, both disclosures being expressly incorporated by reference herein.

The invention relates to a computer system configured to be used at the point of care by the caregiver in a hospital or other health care facility in order to care for patients. The present invention facilitates electronic data entry at the point of care, provides automatic data capture, provides a computer screen with a flow sheet sized proportion, provides access to information at the point of care.

Providing a computer at the point of care provides access to information from a laboratory, pharmacy, radiology, or other locations away from the point of care where it is needed at the point of care. The computer system of the present invention includes both manual and automated patient data entry at the point of care create an electronic record. The present invention permits caregivers to easily input chart data directly into the computer. In addition, the computer receives information automatically from various monitors and medical devices such as vital signs monitors, IV pumps, and the like. Therefore, all data related to the patient is captured at a single location which is located at the point of care. Logon to the computer system of the present invention may be controlled by an IR or RF badge worn by the nurse or caregiver. The computer is designed to remain with the patients in the hospital room and during ambulation or transportation in the hospital. In other words, the computer follows the patient wherever the patient goes from admit to discharge.

Providing a computer at the point of care improves communication. Lab and radiology results are presented electronically to the ordering and consulting physicians at the point of care. The computer system of the present invention facilitates patient care by virtual teams which never actually meet when caring for the patient. The computer system instantaneously captures information related to the patient as well as laboratory procedures and diagnostic procedures ordered for the patient. Information is displayed in an electronic chart or flow sheet on a display.

Illustratively, two adjacent display screens are used to display the patient information. There is little delay in inputting this information to the patient's chart. Such delays often occur with conventional paper charts. Therefore, the present invention reduces the likelihood of ordering redundant lab or diagnostic work on the patient. Electronic referrals, authorizations, and consultations are fast, secure and reliable. E-mail or intranet communications are used to transmit data and automate prescriptions, lab orders, and work flow.

A computer system provides updated access to information and communication at the point of care. Patient data is stored in a memory of the computer or in a main server coupled to the computer by a communication network. Access to all patient information is available to physicians, pharmacy, radiology, lab, cath lab, or any PC connected to the computer at the point of care through a communication network. Doctors or other caregivers at remote locations can view information related to the patient by connecting to the patient's computer or the main server through the communication network. In other words, the computer system acts as a node on the network and can access information from other nodes.

The present invention is also able to capture costs of services and transmit the cost information for billing purposes. For instance, the computer system of the present invention uses a wireless data receiver to receive signals from a badge on the caregiver and from tags on equipment located within the hospital room. Therefore, the computer system of the present invention can determine the actual cost of providing services to the patient. The computer system also includes an input device such as, for example, a keyboard or a bar code reader to capture costs of medication or other treatment or articles used by the patient.

The system of the present invention may be used with the COMposer® communication system available from Hill-Rom. Some details of the COMposer® system are disclosed in U.S. Patent Nos. 5,561,412; 5,699,038; and 5,838,223 which are incorporated herein by reference.

In an illustrated embodiment of the present invention, a patient monitoring system comprises a computer, an input device coupled to the computer and configured to input patient information, and first and second display screens coupled to the computer. The computer displays a first portion of the patient

information on the first display screen and a second portion of the patient information on the second display screen.

In an illustrated embodiment of the present invention, a system comprises a computer including a memory, and a medical device for treating a patient. The medical device includes an indicator configured to provide a signal indicating when the medical device is in use to treat the patient. The system also includes a coupler coupled to the computer for receiving the input signal from the indicator. The computer is configured to store the amount of time that the medical device is in use to treat the patient in the memory.

In one illustrated embodiment, the computer is configured to generate a bill for use of the medical device based upon the amount of time that the medical device is used to treat the patient. The medical device illustratively includes a unique identification so that the computer generates an itemized bill indicating the particular medical device used to treat the patient.

In another illustrated embodiment of the present invention, patient care computer system is provided for use by a caregiver wearing an identification badge which includes a wireless data transmitter that uniquely identifying each caregiver. The apparatus comprises a computer including a memory for storing patient information, a display screen coupled to the computer, an input device coupled to the computer for inputting patient information, a wireless data receiver coupled to the computer, and means for detecting when a caregiver enters a room in which the computer and patient are located. The detecting means determines whether the caregiver is authorized to use the computer system and, if so, automatically logging the caregiver in to the computer system.

In another illustrated embodiment of the present invention, a system comprises means for monitoring at least one physiological condition of a patient on a real time basis, means for recording information related to a treatment of the patient and the time that the treatment was given to the patient, and means for determining the effectiveness of the treatment of the patient by further monitoring the physiological conditions on a real time basis after the treatment.

In another illustrated embodiment of the present invention, a computer system assigned to a patient or to a bed, cart or other device upon which the patient

rests or with which the patient is associated. The system comprises a computer, and a plurality of devices for sensing various physical conditions and characteristics of the patient. Each device has an output coupled to the computer. The system also includes a display arranged to present information related to the patient.

In another illustrated embodiment of the present invention, a system for monitoring patient information comprises a processor, a memory coupled to the processor, a user interface coupled to the processor to permit a caregiver to input instructions into the system, a display screen coupled to the processor, a power supply coupled to the processor, and a connector module configured to couple the system to a medical device including at least one of a physiological monitor, a treatment device, and a therapy device. The medical device uses the processor, the user interface, the power supply, and the display of the system to operate the medical device, thereby reducing redundant components in the medical device.

In another illustrated embodiment of the present invention, a patient monitoring system comprises a computer, a display screen coupled to the computer, and a plurality of physiological monitors coupled to the computer. The computer displays at least two indicators on the display screen related to at least two of a heart rate signal, a respiratory rate, fluid/electrolyte/nutrition information, temperature, neurological monitoring, and blood pressure.

In another illustrated embodiment of the present invention, a patient assist apparatus comprises a base having a plurality of casters, a support coupled to the base, an IV pole coupled to the support, and a brake mechanism coupled to at least one of the casters and to the support. The brake mechanism is configured to brake the at least one caster when a predetermined weight is applied to the support.

In the illustrated embodiment, the apparatus further comprises a spring configured to bias the support upwardly relative to the base and a link coupled between the support and the brake mechanism. The support moves downwardly when the predetermined weight is applied to the support, thereby moving the link to actuate the brake mechanism.

In another illustrated embodiment of the present invention, a walker apparatus comprises a base and a support coupled to the base. The support includes a handle configured to be gripped by a patient. The walker apparatus also includes a

seat having a first end portion and a spaced apart second end portion. The first end portion is pivotably coupled to the support so that the seat is movable between an upwardly pivoted seating position and a downwardly pivoted storage position. The walker apparatus further includes a seat support pivotably coupled to the second end portion of the seat. The seat support is movable from a first position aligned generally parallel with the seat and a second position aligned transverse to the seat to support the seat in the seating position.

In the illustrated embodiment, the apparatus includes a coupler configured to attach the seat support to the seat, the coupler being configured to hold the seat support in the second position automatically when the seat is moved to its upwardly pivoted seating position.

In another illustrated embodiment of the present invention, a patient assist apparatus comprises a walker having a handle to assist movement of a patient, a computer coupled to the walker, a display coupled to the computer, and a movable arm having a first end coupled to the walker and a second end coupled to the display.

In another illustrated embodiment of the present invention, a patient assist apparatus comprises a base having a plurality of casters and a support coupled to the base, the support having first and second sides. The apparatus also includes a latch mechanism coupled to the first side of the support. The latch mechanism is configured to couple the support to a patient support apparatus. The apparatus further includes a handle assembly coupled to the support. The handle assembly includes first and second handles movable from a first orientation located on the first side of the support to provide support handles for a patient to a second orientation located on the second side of the support to provide push handles for use when the support is coupled to the patient support apparatus. In the illustrated embodiments, the patient support apparatus is a bed or a wheelchair.

In another illustrated embodiment of the present invention, a patient computer system comprises a display having first and second display screens located in a room, a cart configured to move with a patient outside the room and to remain with the patient inside the room, a computer coupled to the cart, and a third display screen coupled to the cart. The computer is coupled to the third display screen and coupled to the first and second display screens when the cart is in the room.

In the illustrated embodiment, the computer includes first and second video cards. The first video card is configured to drive the first and third display screens, and the second video card is configured to drive the second display screen.

In another illustrated embodiment of the present invention, a display for a computer comprises a housing having an interior region, a first display screen located in a first portion of the interior region of the housing, and a second display screen located in a second portion of the interior region of the housing. The first and second display screens are coupled to the computer so that the computer displays information on both the first and second display screens. In an illustrated embodiment, the housing includes a first portion and a second portion coupled to the first portion by a waterproof seal.

Additional features of the invention will become apparent to those skilled in the art upon consideration of the following detailed description of the illustrated embodiment exemplifying the best mode of carrying out the invention as presently perceived.

Brief Description of the Drawings

The detailed description particularly refers to the accompanying figures in which:

Fig. 1 is a block diagram illustrating components of the patient point of care computer system of the present invention;

Figs. 2 and 3 illustrate one embodiment of the computer system of the present invention;

Figs. 4 and 5 illustrate another embodiment of the computer system of the present invention;

Figs. 6-8 illustrate yet another embodiment of the computer system of the present invention;

Figs. 9 and 10 illustrate a further embodiment of the computer system of the present invention;

Figs. 11 is a perspective view illustrating the computer system of the present invention in an emergency room;

Fig. 12 is a perspective view illustrating the computer system of the present invention in a neonatal intensive care unit;

Fig. 13 is a perspective view of a computer system module of the present invention within an examination room at a doctor's office or other location;

Fig. 14 is a perspective view illustrating the computer system of the present invention communicating with a badge on a caregiver and tags on equipment within the room for monitoring services provided to the patient;

Figs. 15-17 illustrate an embodiment of the present invention in which the computer system is mounted on an IV pole located within a socket on a hospital bed;

Fig. 18 is a perspective view illustrating a computer module of the present invention installed on a cart;

Fig. 19 is a perspective view illustrating a junction box for providing wireless data transmission of a plurality of medical devices to the computer system of the present invention;

Fig. 20 is a perspective view illustrating a computer module of the present invention attached to a patient assist device used for patient egress;

Fig. 21 is a perspective view illustrating the patient assist device including the computer module used as an IV pole in the hospital room;

Fig. 22 is a side elevational view illustrating the patient assist and computer module docked to a wheelchair;

Fig. 23 is a perspective view illustrating the patient assist device coupled to a hospital bed for transport of the patient with the computer module of the present invention;

Fig. 24 is a perspective view illustrating the patient assist device uncoupled from the hospital bed and left in the room with the patient for a diagnostic procedure;

Figs. 25-27 illustrate one embodiment of a workstation for use with the computer system of the present invention;

Figs. 28 and 29 illustrate another embodiment of a workstation;

Fig. 30 is a perspective view illustrating yet another workstation including the computer system of the present invention;

Fig. 31 is a perspective view of a support stand for receiving a computer module;

Figs. 32 and 33 illustrate another stand for receiving the computer system;

Fig. 34 is a block diagram illustrating inputs to the electronic flow sheet or chart generated by computer 12 on display screens 18 and 20;

Fig. 35 is a block diagram of the present invention in which medical device modules are coupled to a central station to reduce redundant systems in the medical devices;

Figs. 36-38 illustrate a modular system shown diagrammatically in Fig. 34;

Figs. 39 and 40 illustrate a computer integrated with an overbed table for use by a patient in the hospital room;

Fig. 41 illustrates another embodiment of a display apparatus configured to be coupled to the computer of the present invention including a first stationary display and a second removable display which is smaller than the first stationary display;

Fig. 42 is a perspective view of another embodiment of the present invention illustrating a module configured to be coupled directly to the patient, to the patient support, or to the patient assist device for receiving signals from physiological monitors and using telemetry to transmit these monitor signals to the computer or to a server located at a remote location;

Fig. 43 is another embodiment of the present invention illustrating a computer module and a third display located in a separate housing from the first and second displays located in the hospital room, the computer module and the third display being mounted to the patient support apparatus;

Fig. 44 is an illustrative display screen of one embodiment of the present invention;

Figs. 45 and 46 illustrate another embodiment of a movable work station including a movable cart for supporting a computer system of the present invention;

Figs. 47A, 47B, and 48 are illustrated examples of the types of display information and data entry capabilities of the computer system of the present invention;

Fig. 49 is a perspective view of another embodiment of a patient assist cart having a computer mounted thereon;

Fig. 50 is a perspective view of the patient assist cart of Fig. 49 with the computer removed;

Fig. 51 is a perspective view of the computer of Fig. 49 removed from the patient assist cart;

Fig. 52 is a side elevational view of the computer of Fig. 51;

Fig. 53 is a perspective view of another embodiment of the present invention illustrating the computer display screen mounted on a movable support arm on the patient assist cart, a seat in an upwardly pivoted patient support position, and push handles in a first position;

Fig. 54 is a perspective view of the patient assist cart of Fig. 53 illustrating the patient support seat in a downwardly pivoted storage position and illustrating push handles moved to a second position for pushing a bed or other device coupled to the patient assist cart;

Figs. 55 and 56 are perspective views illustrating components of a computer coupled to the cart of Figs. 53 and 54;

Fig. 57 is a perspective view of the patient assist cart of Figs. 53 and 54 with additional equipment loaded on the cart;

Fig. 58 is a perspective view of the cart of Fig. 55 illustrating movement of display screen and an input device on a movable arm;

Figs. 59 and 60 illustrate operation of a seat of the patient assist cart;

Figs. 61 and 62 illustrate a latching mechanism and movable push handles of the patient assist cart;

Figs. 63 and 64 illustrate a mechanism for securing and unsecuring the push handles relative to a support post of the patient assist cart;

Fig. 65 illustrates a castor breaking apparatus of the present invention;

Figs. 66-68 illustrate a support arm for the display screen of the computer;

Figs. 69 illustrates the patient assist cart coupled to a hospital bed;

Figs. 70-72 illustrate operation of a latching mechanism for coupling the bed or another device to the patient assist cart;

Fig. 73 illustrates the patient assist cart coupled to a wheelchair.

Figs. 74-76 illustrate details of a sealed housing configured to receive first and second display screens;

Figs. 77 and 78 illustrate a support arm for coupling a dual screen display housing to a wall, cart or other device;

Figs. 79A-C illustrates another embodiment of a primary support arm of the present invention.

Figs. 80-82 illustrate various orientations fo the dual screen display in a hospital room;

Fig. 83 illustrates details of video cards in a computer coupled to first, second and third display screens;

Fig. 84 is a block diagram illustrating one embodiment of electronic circuitry for coupling a computer on a patient assist apparatus or workstation to a dual monitor display mounted in a room;

Fig. 85 is a block diagram illustrating another embodiment of the electronic circuitry for coupling the computer on the patient assist apparatus or workstation to the dual monitor display mounted in the room; and

Fig. 86 is a block diagram illustrating a further embodiment of electronic circuitry for coupling the computer on the patient assist apparatus or workstation to the dual monitor display mounted in the room.

Detailed Description of the Drawings

Referring now to the drawings, Fig. 1 illustrates a block diagram of a patient point of care computer system 10 of the present invention. Computer system 10 is designed to provide improved access to data at the point of care. Centralized computer system 10 organizes numerous monitors, treatment devices, and therapy devices and facilitates record keeping by providing a real time electronic chart for the patient. The computer system 10 of the present invention also improves communications between various caregivers who are members of a care team for the

particular patient. The computer system 10 automates processes for ordering tests and communicating between various caregivers working with a patient.

Computer system 10 includes a computer 12 which is designed to stay with the patient during an entire stay at a hospital or other medical facility. Computer 12 is coupled to a memory 14 for storing and retrieving data. Computer 12 is also coupled to a display 16 which illustratively includes first and second displays 18 and 20 as discussed below in detail. Computer 12 is further coupled to at least one input device 22. The input device 22 includes a pen or stylus based input, a keyboard, a mouse, a joystick, a voice recognition input, a touch screen, or other suitable input device. The input device 22 permits a caregiver or other individuals to input patient information or other desired information into the computer 12.

Computer 12 is also coupled to a communication network 24. Communication network 24 permits computer 12 to transmit and receive information from a remote location. Information related to the patient stored in memory 14 of computer 12 can be accessed by a doctor at a remote location. In addition, e-mail messages or other order messages can be transmitted over the communication network 24 to other locations both inside and outside the hospital. Therefore, a caregiver can schedule tests or request certain medications or procedures using the input device 22 of computer 12. These orders or prescriptions are then automatically transmitted over the communication network 24 to the proper location. In addition, information such as test results can be sent over the communication network to computer 12 so that the caregiver can access all information related to the patient at the point of care.

As discussed below, the computer 12 may be coupled to monitors 26, treatment devices 28, and therapy devices 30 through a physiological monitoring module or coupler 32. Illustratively, coupler 32 may be an RS-232 part or other suitable connector. Computer 12 processes signals from the monitors 26, treatment devices 28, and therapy devices 30 on a real time basis. This information is used to provide an electronic chart of patient conditions on display screens 18 and 20. The monitors 26, treatment devices 28, and therapy devices 30 include, but are not limited to, heart rate monitors, temperature sensors, blood pressure monitors (invasive and noninvasive), EKG monitors, blood oxygen sensors, capnographs, ventilators, IV pumps, scales, chest drainage monitors, and the like.

Computer 12 is also coupled to a bar code reader 34. Bar code reader 34 is either a standard bar code reader or a 2D bar code reader. The bar code reader 34 permits a caregiver to scan a bar code to indicate the type of drugs given to the patient in order to capture costs and the time that the drugs are administered. Bar code reader 34 may be used on any other item given to the patient or on equipment in the room. An RFID receiver/reader 35 is also coupled to the computer 12 in another embodiment to read transmitted RFID signals.

Computer 12 is also coupled to a wireless data receiver 36. Data receiver 36 is illustratively an IR or RF receiver. It is understood, however, that the wireless data receiver could be any type of receiver. Receiver 36 is configured to receive transmission signals from wireless transmitters 38. Transmitters 38 are typically included in badges worn by personnel or on tags on equipment. As discussed below, the wireless data receiver 36 monitors the time and type of equipment and personnel within the vicinity of the point of care. Computer 12 is also coupled to a wireless data transmitter 40. Transmitter 40 is configured to transmit signals to a receiving station within the hospital such as, for example, when computer 12 is disconnected from the communication network 24 during transport of a patient from one location to another.

Computer 12 is also coupled to a camera 42. Video signals from camera 42 can be transmitted by computer 12 to a remote location using the communication network 24 or the wireless data transmitter 40. An Internet protocol such as video over IP may be used if desired. Therefore, a doctor at a remote location can view an image of the patient. The video signal from camera 42 may also be taped using conventional magnetic tape storage devices.

In an illustrated embodiment, computer 12 is also connected to the phone 44. Therefore, the caregiver or patient can use the phone 44 to place telephone calls in a conventional manner or using an Internet protocol such as voice over IP. In addition, messages or warnings can be transmitted by the computer 12 over phone 44. For instance, if a caregiver receives an e-mail message on computer 12, the message can also be transmitted to the caregiver via phone so that the caregiver can be paged or delivered a message by voice mail. Voice mail message or instructions received on the phone line can also be converted to e-mail message and transmitted to another

location via communication network 24 or transmitter 40 or stored on computer 12 for access by a caregiver at computer 12.

The computer system 10 provides access to information at the point of care from the lab, pharmacy, radiology, and other locations that may be inside or outside of the hospital but that generate information relevant to the care of the patient. An electronic record is stored in memory of a server 15 coupled to computer 12 by communication network or wireless connection for access by the computer 12 at the point of care. However, it is within the scope of the invention as presently perceived to instead or additionally store the electronic record in memory 14 of computer 12 for access at the point of care. Patient information data is integrated on to a chart which is displayed on the large display 16 including both display screens 18 and 20. The computer system 12 integrates data manually input into the computer using input devices 22 with real time data available from monitors 26, treatment devices 28, therapy devices 30, bar code reader 34, and wireless data receiver 36. As discussed below, the computer 12 remains with the patient during transport and at the other locations in the hospital such as, for example, for diagnostics, the operating room, and the like.

Figs. 2-10 illustrate various embodiments of components of computer system 10 of the present invention. Figs. 2 and 3 illustrate display 16 which includes a first display screen 18 and a second, removable display screen 20. Display screen 20 is on a removable module 50 which is removable from a support 52, having a support plate 54 and a handle 56 coupled to the support plate 54. It is understood that a single larger, elongated display may be used instead of separate display screens 18 and 20. However, for cost reasons or other reasons, two displays 18 and 20 are used to provide the larger overall display 16. It is also understood that more than two display screens may be coupled to support 52 if needed as discussed below.

In the illustrated embodiment, display screen 18 is fixed to the support 52. Bar code reader 34 is storable within a recess 58 of support 52. Bar code reader 34 is removed in the direction of arrow 60 for scanning items such as drugs or equipment supplied to the patient. Input device 62 is also coupled to the support 52. Plate 54 illustratively includes a connector 64 which automatically provides connection between module 50 and the rest of the system when the module is loaded

onto support 52 in the direction of arrow 66. It is understood that various connecting cords may also be used to couple module 50 to the other components of computer system 10. The connector 32 is configured to couple signals from monitors 26, treatment devices 28, and therapy devices 30, to an inlet port on module 50 when connector 32 is installed in the direction of arrow 68 of Fig. 2. Wireless data transmitter 36 may also be coupled to module 52 by installing the transmitter 40 in the direction of arrow 70.

The computer system 10 uses both display screens 18 and 20 to provide a flow sheet dimension in order to display the flow sheet for the patient in electronic form so that the paper chart does not have to be manually updated. As discussed below in detail, real time data from monitors 26, treatment devices 28, and therapy devices 30, are used to continuously update the flow sheet with real time data. The caregiver can input information into the computer 12 using an input device such as the stylus or pen 72 shown in Fig. 3. Illustratively, display screens 18 and 20 include touch screen technology so that information can be input by simply touching portions of the screen. In addition, an input pad section 74 permits the caregiver to write with the pen 72 to input information. Computer 12 includes handwriting recognition software such as, for example, CalliGrapher 5.3 for Windows software available from ParaGraph, so that computer 12 recognizes the characters written on input pad 74.

Figs. 4 and 5 illustrate another embodiment of the present invention. Those numbers referenced by numbers from Figs. 1-3 perform the same or similar function. In Fig. 4, base support 52 includes a housing 76 formed to include an aperture 78 for receiving the pen 72 in the direction of arrow 80.

A physiological monitoring module 82 is coupled to housing 76. Module 82 includes a plurality of sockets 84 configured to receive connectors 86 coupled to the monitors 26, treatment devices 28, or therapy devices 30, as illustrated by arrows 88. Fig. 5 illustrates the caregiver inputting information using the pen 72. A handle 51 is coupled to module 50 to permit easy removal of the module 50 from the remainder of support 52. An arm assembly 53 is configured to couple the computer system 10 to a suitable support structure in the room, on the bed, or on a separate cart or stand, as discussed below in detail.

Another embodiment of the present invention is illustrated in Figs. 6-8. This embodiment shows a modular physiological monitoring interface 90 configured to be coupled to module 50. Physiological monitoring interface 90 includes a separate housing 92 having a locking mechanism 94 configured to secure the interface 90 to a support plate 96 which is pivotably coupled to a support arm 98. Physiological monitoring interface 90 further includes the connector 98 formed to include a plurality of sockets 100 for receiving connectors coupled to the monitors 26, treatment devices 28, and therapy devices 30. The wireless data transmitter card 102 is also coupled to the interface housing 92. Physiological monitoring interface 90 may include its own processor and memory for receiving the inputs from the various monitors 26, treatment devices 28, and therapy devices 30. In another embodiment, interface 90 provides a physical connection between the monitors 26, treatment devices 28, and therapy devices 30, with main computer 12 located in module 50, but does not include any processor of its own.

Figs. 6 and 7 show module 50 which includes display screen 20 coupled to physiological monitoring interface 90. A lock 104 is provided to secure module 50 to the interface 90. In the illustrated embodiment, module 50 includes a connector 106 configured to mate with a connector on interface 90 to provide electrical connection between the computer 12 within module 50 and the interface 90. In another embodiment, a separate cord may be used to provide the electrical connection between module 50 and interface 90. In addition, when physiological monitoring is not needed, module 50 can be coupled directly to base plate 96. Module 50 and interface 90 can be removed from base plate 96 as a unit as shown in Fig. 7. Therefore, the computer 12 along with monitoring capabilities may be coupled to the bed or a cart adjacent the bed as discussed below for transport with the patient to various locations within the hospital. If it is desired only to transport module 50 including the computer 12 without the physiological monitoring capability, module 50 is removed from interface 90 and coupled to the bed or cart for transport with the patient to the remote location.

Figs. 9 and 10 illustrate yet another embodiment of the present invention in which the phone 44 and video camera 42 are illustrated. The caregiver 110 shown in Fig. 10 is able to see a video image 112 on display 16 through video

camera 42 mounted on a computer housing 114 in a patient's room shown in Fig. 9. The caregiver 110 may also access chart information related to the patient at the remote location. Figs. 9 and 10 illustrate the phone 44 coupled to the housing 114 by line 116. The patient can see the video image of the caregiver 110 location 118 in Fig. 9. Figs. 9 and 10 also illustrate buttons 120 for dialing the phone 44.

As discussed above, the computer system 10 of the present invention is designed to have flexibility in order to follow a patient throughout the stay in the hospital. The computer system 10 is capable of being located within the room to collect data at the point of care. The computer 10 may also be moved out of the room to enter data, such as in a hallway. Therefore, the electronic chart or flow sheet generated by the computer and all associated data follows the patient throughout the stay at the hospital.

Fig. 11 illustrates the computer system 10 in an emergency room of the hospital. The patient 122 is located on a stretcher 124 containing a patient support surface 126 carried on a base 128, which is movable on casters 130. Computer system 10 is mounted on a rail 132 of head wall 134 by mounting bracket 136. Illustratively, bracket 136 may slide along rail 132 in the directions of double-headed arrow 138. Computer system 10 is also pivotable on an arm 140 coupled to bracket 136 to adjust the position of the display 116 for viewing by caregivers 142, 144. Physiological monitors such as heart rate monitors 146 and 148 are coupled to an inlet connector 32 of computer system 10 by lines 150. Computer system 12 records output from the sensors on a real time basis and displays the outputs on display screen 18 or 20. Screens 18 and 20 are reversed in the embodiment shown in Fig. 11. Computer 12 also stores the data from the monitors for charting purposes. Data from treatment devices 28, such as IV pump 152 is also stored by computer 12. Caregivers 142 and 144 can input information into computer 12 via any of the input devices 22.

Fig. 12 illustrates the computer system 10 in a neonatal intensive care unit (NICU). In Fig. 12, the computer system 10 is located near an incubator 160 which provides a thermal support device for an infant 162. Computer 12 monitors vital signs of the infant 162. Computer 12 is also illustratively coupled to the controller of the incubator 160 to monitor the conditions within the incubator 160. Any treatments given to the infant can also be entered into computer system 12

manually using input devices 22, bar code reader 34, or a wireless data receiver 36. In the Fig. 12 embodiment, computer system 10 is mounted to a head wall 164 by bracket 166. Arm 168 is pivotable relative to bracket 166. If it is necessary to transfer the infant to another location, removable module 50 of computer system 10 is removed and attached to the incubator 160 for transport. Module 50 includes computer 12 and display 20, as well as connector 32 for monitors 26, treatment devices 28, and therapy devices 30. Therefore, computer 12 continues to capture real time data related to the infant 162 during transport. Wireless data transmitter 40 is used to communicate with base units within the hospital during transport.

Fig. 13 illustrates the computer module 50 coupled to the wall in an examination room by bracket 170 and arm 172. The examination room may be in the hospital, a doctor's office, or other health care facility. In Fig. 13, a patient 174 is seated on an examination table 176. Examination table 176 illustratively includes a scale 178, having an output coupled to computer module 50 so that the weight of the patient is automatically recorded by computer 12. It is understood that the entire computer system 12 including the dual display 16 discussed above may be used within the examination room. However, for cost reduction purposes, a single display on module 50 may be adequate for the examination room. The temperature thermometer 180 and blood pressure cuff 182 are also coupled to the connector 32 coupled to module 50 by lines 184. Therefore, computer 12 automatically captures the patient's temperature and blood pressure reading. The caregiver 186 inputs additional information using input device 22 which is illustratively a touch screen or pen based system. Patient symptoms may also be entered so that a doctor entering the room later can access complete information regarding the patient 174. This patient chart information is coupled to a communication network 24 so that the information can be transmitted to a remote location, such as a hospital, if information related to the patient is needed at a later time.

Another embodiment of the present invention is illustrated in Fig. 14. In this embodiment, the wireless data receiver 36 is used to receive data from badges 190 on caregivers 192. Tags 194 are also located on the medical equipment within the room. The badges 190 and tags 194 transmit signals such as infrared signals or RF signals which are received by receiver 36. The signals from badges 190 and tags 194

include identification information to identify the particular caregiver 192 or the particular type of equipment located in the room. Computer system 12 monitors the time that particular caregivers 192 and equipment are located within the room. The signals from tags 194 can include status information (such as in use or at rest). By knowing the location of equipment and the status of the equipment at all times, the computer can determine the amount of time that equipment is in use for each patient. Therefore, the hospital can determine the real cost of providing care to a patient 196. In addition, computer 12 can generate an itemized bill indicating the time and duration that equipment is used in treating the patient and the time spent by the caregiver 12 within the room. This cost information can be either maintained for internal purposes or transmitted to a billing station for charging each patient for the exact amount of equipment and caregiver time used.

In the illustrated embodiment, computer system 10 identifies the caregiver 192 based upon signals transmitted from badge 190 to receiver 36. Upon recognizing an authorized caregiver 192 entering the room, computer 12 automatically logs the user onto the system 10. Any email or phone messages can be given to caregiver 192 via the display 16. Caregiver 192 can also be alerted when results of tests ordered by the caregiver 192 are available.

Fig. 15 illustrates another embodiment of the present invention in which the computer system 10 is coupled to a bed 200 by a coupling mechanism 202 which includes a pin 204 configured to be located within an IV socket 206 of bed 200. Pin 204 extends away from hub 208. Hub 208 includes a bracket 210 which is pivotally coupled to arm 212. The opposite end of arm 212 is pivotally coupled to bracket 214 of computer system 10. An IV pole 216 supports IV bags 218 and pumps 220. By coupling the computer system 10 to bed 200, computer system 10 is transportable with the bed 200 during transport as shown in Fig. 17. Therefore, computer 12 continues to capture data from the monitors 26, treatment devices 28, and any therapy devices 30 on a real time basis during transport of the patient within the hospital 10. Wireless transmitter 40 and receiver 36 permit computer 12 to remain in contact with the base station in the hospital during transport.

Fig. 18 illustrates another embodiment of the present invention in which the removable module 50 has been removed from support 52 and coupled to a

cart 220. Cart 220 includes a base 222, a support 224 for holding a ventilator 226, and pivotable IV poles 228 and 230. Illustratively, cart 220 is a Careporter cart available from Hill-Rom, Inc. as disclosed in U.S. Patent No. 5,966,760 and in U.S. application Serial No. 09/105,255 which are incorporated herein by reference. Cart 220 includes a pivotable support arm 230 for receiving module 50. Module 50 includes display 20, connector 32, wireless data transmitter 40, along with computer 12, memory 14, and input device 22.

Fig. 19 illustrates a junction box 240 having a wireless transmitter such as an RF transmitter 242. The junction box 240 includes a plurality of inlet connectors 244 configured to be coupled to physiological monitors, IV pumps, or other devices 246 that do not have individual transmitters. For example, junction box 240 may be used in a critical care unit with all the devices 246 coupled to inlet connectors 244. Therefore, the hospital does not have to undergo the expense of placing a transmitter on each device 246. Transmitter 242 transmits data from the devices 246 to the wireless data receiver 36 of computer system 10 located on the bed or a cart adjacent the bed.

Junction box 240 includes an internal memory 248 for storing a selected amount of data from the devices 246. Power cord 250 for junction box 240 is designed to be plugged into a suitable power outlet.

Junction box 240 also includes a wireless receiver 252 for receiving data from the wireless data transmitter 40 of computer system 10. Junction box 240 also illustratively includes a processor 240 which is programmed to recognize devices 246 coupled to the junction box 240. Junction box 240 communicates with computer 12, transmitter 242 and receiver 252. Processor 254 determines whether the computer system 10 is within range for transmission of data by determining whether signals from the computer system 10 are detected by receiver 252. If the computer 10 is within range for receiving data transmission from the junction box 240, data from devices 240 is transmitted by transmitter 242 from data receiver 36 where computer 12 stores the data in memory 14. If computer system 10 is not within range to receive data, processor 54 stores data from the devices 246 in memory 248 of junction box 240. When processor again determines that computer system 10 is within transmission range, processor transmits the stored data from devices 246 to the

wireless data receiver 36 of computer system 10. Therefore, information for charting purposes is supplied to computer system 10 without requiring transmitters on each of the devices 246.

Figs. 20-24 illustrate various uses for a patient assist apparatus 260. Patient assist apparatus 260 includes a base 262 having casters 264. A support portion 266 is coupled to base 264. Air or oxygen tanks 268 are coupled to support portion 266. IV poles 270 are also coupled to patient assist 260. A handle 272 is coupled to an upper end of support 266. A computer support 274 is also coupled to the upper end of support 266. Computer support 274 is configured to receive computer module 50 which is illustratively removed from the total computer system 10 as discussed above. Module 50 includes a single display 20, a computer 12, memory 14, wireless data receiver 36, wireless data transmitter 40, and coupler 32 for connecting the computer 12 to monitors 26, treatment devices 28, and therapy devices 30. Therefore, vital signs of the patient 276 as well as outputs from various devices such as IV pumps 278 are captured real time by computer 12. Display 20 also displays the patient's vital signs. Patient data is transmitted via the wireless data transmitter 40 to a communication network 24 or stored in local memory. In Fig. 20, the patient assist 260 is used as a walker-type device to assist with patient egress after medical procedures such as surgery. The patient assist 260 helps the patient 276 maintain his balance and keeps the computer 12 at the point of care.

Fig. 21 illustrates the patient assist 260 and computer module 50 for use as an IV pole within the room. Caregiver 280 inputs information related to the patient 276 using pen 72 as discussed above. Fig. 22 illustrates the patient assist 260 coupled to a wheelchair 282. Caregiver 280 uses handle 272 to push the wheelchair 282. A coupling mechanism is used to secure the patient assist 260 to the wheelchair 282. Again, computer module 50 is able to monitor and record data from monitors 26, treatment devices 28 and therapy devices 30 during transport of the patient. In addition, all the patient's information and chart are available on display 20 during transport. Fig. 23 illustrates removable module 50 from support 52 within the room as illustrated by arrow 284. Module 50 is then loaded on to patient assist 260 as illustrated by arrow 286 for transport of the patient on the bed 290. Caregiver 280 is able to view the patient's chart and vital signs during transport on display 20. Patient

assist 260 is coupled to bed 290 by a suitable latching mechanism. Fig. 24 illustrates that the patient assist 260 may be uncoupled from bed 290 at the testing facility such as the CT scanner 292. Patient 276 is removed from bed 290 and placed on table 294. Patient assist 260 is uncoupled from bed 290 and left beside the patient 272 when the bed 290 is removed from the room. Therefore, computer 12 located within module 50 continues to capture patient data and data from the monitors and treatment devices while the patient 270 is at the testing facility. All previous test results and chart information are available to the caregiver at the test facility. In addition, the chart remains complete on a real time basis. In certain instances, test results can be automatically transmitted to computer 12. In other instances, test results are obtained later and transmitter to the computer 12 via the communication network 24. Since all test results and lab results are available at the point of care, the present invention reduces the likelihood of duplicate testing on the patient 272.

In the embodiment of Figs. 20-24, data related to the patient is transmitted by wireless data transmitter to a central nurse station or to the main server for transmission to any location. Therefore, patient's vital signs or other information can be displayed or monitored at the central station.

When in the room, the computer system 10 is also used as a tool to educate the patient. Information related to the patient's particular diagnosis or condition is provided to the patient so that the patient understands the care plan for treating the patient's condition. Computer 12 is also used to assist compliance with a doctor's instructions after release. For instance, informative information can be provided on display 16 with instructions for the patient after release. Display 16 can also be used as a TV set when the caregiver is not in the room.

Figs. 25-27 illustrate a workstation 300 located in a hospital room adjacent the bed 302. It is understood that the workstation 300 can be used in the hallway or at another location outside the hospital room. Computer system 10 is shown on an opposite side of the bed 302 from workstation 300. It is understood that workstation 300 may also be on the same side of the bed as computer system 10. Illustratively, workstation 300 includes an upper cabinet 304, a light 306, a keyboard 308, and a support 310. Computer system 10 is movable from the support arm 312 to support 310 on workstation 300. Data is entered into computer system 10 using pen

72 or other input device including the keyboard 308. Computer system 10 continues to monitor and record data from monitors 26, treatment devices 28 and therapy devices 30 when on workstation 300. An additional cabinet 312 is located below keyboard 308. It is understood that cabinet 312 may be formed integrally with the rest of workstation 300 or may be a separate piece as shown in Fig. 26 which is movable in the direction of arrow 314. As shown in Fig. 27, a curtain 316 is illustratively provided adjacent workstation 300 to permit the caregiver 318 to enter information into the computer system 10 in privacy. Keyboard 308 is retractable into a central storage section 320 as illustrated in Fig. 26. Figs. 29 and 30 illustrate another embodiment of a workstation 322 as shown in Figs. 28 and 29. Workstation 322 includes a central open region 324, an upper storage cabinet 326, and a shelf 328. Computer system 10 mounted on a support arm 330 and is pivotable from a position located adjacent bed 332 at the patient's point of care to a position shown, for example, in Fig. 29 in which the computer 10 is pivoted within space 324 for access by a caregiver at workstation 322. A separate keyboard 332 is provided on workstation 322 for inputting additional information into the computer system 10. A movable cabinet 334 is located beneath the shelf 328. It is understood that the entire workstation 322 may be on a mobile cart so that the workstation 322 is movable as a unit within the room.

Figs. 30-33 illustrate additional carts for supporting the computer system 10. In Fig. 30, cart 340 includes a base 342 and a central portion 344 coupled to the base 342. The central portion 344 includes drawers 346. A stand 348 is located on top surface 350 for supporting the computer system 10. A screen or partition 352 is coupled to central portion 344 and extends 180° or more around top surface 350 for privacy. Caregiver 354 can rotate the stand 340 as illustrated by double headed arrow 356 away from the patient 358 as desired for privacy when inputting information into the computer system 10.

Another cart 360 is illustrated in Fig. 31. Cart 360 includes a base 362 having casters 364. A central pedestal 366 includes telescoping portions 368 and 370. A wire storage tray 372 is coupled to telescoping section 368. Controls 374 and 376 are provided for raising and lowering telescoping sections 368 and 370. Work surface 378 includes handles 380 and 382. Either module 50 of computer system 10 or the

entire computer system 10 is configured to be coupled to a support 382. Pullout keyboard 384 is located under work surface 378. Surface 378 may include an input device such as device 74 in Fig. 2 which permits the caregiver to write out information to be input into the computer 12 which is recognized by handwriting recognition software.

Yet another cart 390 is illustrated in Figs. 32 and 33. Cart 390 includes a central portion 392 having drawers 394. Legs 396 and casters 398 are coupled to central portion 392. Stand 390 includes an angled top work surface 400 and a keyboard 402 which can be moved to an extended position in the direction of arrow 404 in Fig. 33 for access by a caregiver 406. Computer 10 is coupled to a telescoping support arm 408 by a pivot connection 410. Arm 408 can extend and retract in the direction of double-headed arrow 412 in Fig. 33 to raise and lower the height of computer 10. Computer 10 is also pivotable about axis 412 as illustrated by double-headed arrow 414 in Fig. 33.

Fig. 34 illustrates a summary of the real time electronic charting feature of the present invention. As discussed above, dual displays 18 and 20 permit replication of a chart approximately the size of a conventional flow sheet used to keep patient records in the hospital. The dual displays 18 and 20 also permit viewing of two separate software application simultaneously. It is understood that a single display may be used. However, dual displays are used for cost saving purposes in order to provide the chart information. In other words, a portion of the chart data is displayed on the first display screen 18 and another portion of the patient data chart is displayed on the second display screen 20. Computer 12 inputs information in a real time basis on the chart from monitors 26, treatment devices 28 and therapy devices 30. In other words, the computer 12 monitors these devices to provide real time information which normally is kept on patient's charts or flow sheets. For example, computer 12 automatically charts information related to temperature, respirations, rhythm, heart rate, blood pressure, blood oxygen levels, or any other vital sign which is desirable to monitor. The computer 12 graphs this information on a continuous, real time basis on the chart.

Computer 12 also monitors the bed status as illustrated at block 420. Bed status 420 includes information related to the location of various bed deck

sections or other information related to the mechanical features of the bed. Computer 12 also monitors bed based therapy devices as illustrated at block 422. These therapy devices include, for example, thermal treatment devices, percussion, vibration, or rotation therapy provided for the patient. Computer 12 monitors the actual time and duration that such therapies are performed. Computer 12 indicates these therapies on the chart so that the results of these therapies can be monitored for effectiveness by viewing the time that the therapy is performed and then determining whether the patient's condition improves based on the therapy. Computer 12 also monitors medications administered using the bar code reader 34, RFID reader, or other input device as indicated by block 424. Again, by charting these medications on a real time basis, the caregiver can determine the effectiveness of medications by monitoring the other vital signs in relation to the time that medications are administered. Test results are also monitored by computer 12 as illustrated at block 426. These test results are charted, if appropriate, to assist with analysis of the effectiveness of the various treatments. As discussed above the charting from the monitors continues regardless of whether or not the patient is in the room. The modular interface card is provided for connecting the monitors, treatment devices, and therapy devices to the computer system 10. An open system permits devices from various manufacturers to be coupled to the system 10. Therefore, vital signs are archived and automatically downloaded to the flow chart regardless of whether or not the patient is in the room. This provides a more complete chart when compared to conventional paper charts.

Computer 12 may also be coupled to a smart mattress such as disclosed in PCT Application No. PCT/US99/25311 which is incorporated herein by reference. The smart mattress generates output signals related to a patient's weight, heart rate, respirations, temperature, EKG, ECG, $SaO_2$, and the like which are monitored and charted by the computer 12.

Another embodiment of the present invention is illustrated in Fig. 35. The embodiment of Fig. 35 provides a fully integrated care delivery system 500. The system 500 provides open architecture which allows medical equipment manufacturers to produce module products to function with the system 500. These medical device manufacturers access common hardware and redundant systems so that the modular devices are smaller and lighter. The smaller and lighter modular

devices facilitate ergonomic benefit and their placement within the environment. The entire system 500 also has cost advantages by reducing these redundant systems. System 500 includes a central station having a central processing unit (CPU) 504, a power supply 506, a battery backup 508, a display 510, and a graphical user interface 512. User interface 512 may include any type of input device discussed above. Medical device modules 514 configured to be coupled to a plurality of input connectors 516 of station 502. Illustratively, the medical devices of modules 514 are vital sign monitors, IV pumps, ventilators, defibulators, compression boots, and other medical devices that may be used to provide or monitor the care of a patient. Modules 514 illustratively do not include a CPU, a power supply, a display, or a user interface. When modules 514 are connected to connector 516, modules 514 include a suitable connector 518 so that modules 514 use the CPU 504, power supply 506, battery backup 508, display 510, and user interface 512 of the central station 502.

Central station 502 provides an open architecture to allow all medical equipment manufacturers to produce modules 514 to function with the system 500. System 500 includes other components (not shown) such as the connection to the communication network 24, the bar code reader 34, wireless data receiver 36, wireless data transmitter 40, camera 42, and phone 44 as discussed above with reference to Fig. 1. CPU 504 also accesses memory 518. Modules 514 are less expensive since redundant systems are not used. Only the actual treatment portions of the devices are required in the modules 514. Control of the modules 514 is provided using the graphic user interface 512 of station 502. Information regarding operation of the module 514 is displayed on display 510 instead of on a separate display on the module 514. Power is supplied to the module 514 via the power supply 506 if the station 502 is connected to a wall outlet or via a backup battery 508 if the station 502 is disconnected from the wall outlet such as, for example, during transport. Once the modules 514 are connected, the system 500 operates as discussed above to capture data for charting patient information throughout the patient's entire stay at the hospital.

Figs. 36-38 illustrate an embodiment of the invention shown in Fig. 35. This embodiment, a cart 520 includes a base 522 supported by casters 524 and a central portion 526 for housing a ventilator 528 and defibulator 530. A handle 532 is

provided for pushing the cart 520. A first support arm 534 is coupled to hub 536. A module receiving section 540 includes a plurality of module receiving cavities 542 for receiving modules 544. Computer system 500 is coupled to a second arm 546 attached to hub 536. Display 510 includes dual screens. Medical device module such as modules 544, as well as ventilator 528 and defibulator 530 are similar to modules 514 illustrated in Fig. 35. In other words, these modules use the CPU 504, power supply 506, backup battery 508, display 510, and user interface 512 of the computer system 500. Fig. 36 illustrates the cart 520 being pushed toward bed 548 in the direction of arrow 550. A large display 552 is coupled to a wall adjacent bed 548. Display 552 is also coupled to computer system 500 via the communication network or a wireless transmitter to display information related to the patient on the display screen 552. When caregiver 554 is not in the room, another image such as a picture or TV image may be provided on display screen 552. Fig. 37 illustrates the cart 520 at a location adjacent the head end of bed 548 for providing access to computer 500 at the point of care near the head end of the patient 556. Fig. 38 illustrates the cart 520 docked to the bed 548 during transport. Fig. 38 also illustrates one of the modules 544 removed from module receiving cavity 542. In addition, Fig. 38 illustrates how ventilator 528 is connected to cart 520.

Figs. 39 and 40 illustrate another embodiment of the present invention. In Fig. 39, a computer 600 is integrated with an overbed table 602. Table 602 includes a base 604 supported by casters 606. Table 602 further includes a side support 608 having storage portions 610 and a top cavity 612. A connector 614 is coupled to a computer support 616. Illustratively, support 614 is rotatable about axis 618 as shown by arrows 620. Computer system 600 includes a personal computer including a display 622. A phone 624 is integrated with the computer 600. It is understood that the phone could be separate from the computer 600. Fig. 40 illustrates the overbed table positioned over a hospital bed 626 so that the computer 600 is accessible to patient 628. Therefore, the patient 628 has access to e-mail, the Internet, a care plan, or other items such as computer games. The patient 526 can conduct business or send e-mails to the doctor to ask questions.

Another embodiment of the present invention is illustrated in Fig. 41. In the Fig. 41 embodiment, a display apparatus 630 is used in place of display

apparatus 16 shown in Fig. 1. Display apparatus 630 includes first and second display screens 632 and 634 coupled to a base or support 636. Illustratively, display 634 is removable from base 636 as a separate module along with computer 12. A connector 638 illustratively includes male and female portions for connecting the computer 12 to the first display 632 when the computer 12 and second display 634 are coupled to the base 636. First display 632 includes a height dimension 640 and a width dimension 642. Second display 634 includes a height dimension 644 and a width dimension 646. As illustrated in Fig. 41, the height and width dimensions 640 and 642 of first display 632 are larger than the height and width dimensions 644 and 646 of second display 634. Therefore, the removable display 634 is smaller than the stationary display 632. A top edge 648 of first display 632 is illustratively aligned with a top edge 650 of second display 634 on support 636. In the illustrated embodiment, chart information or other patient information is provided on both displays 632 and 634. Illustratively, the charting data is only provided in a top portion of display 632 as illustrated by dimension 652. Dimension 652 is the same height as height dimension 644 of second display 634. A lower portion of first display 632 illustrated by dimension 654 is illustratively used for providing menu items or icons. Section 654 of screen 632 may also be used as a pen or stylus based input section which provides handwriting recognition as discussed above. It is understood that additional display screens may be coupled to base 636, if desired.

When it is desired to transport the patient or permit the patient to move about in the hospital, the computer 12 and display 634 are removed from base 636 and coupled to the bed, patient assist, stand or other device as discussed above so that the computer 12 and display 634 remain with the patient at the point of care as the patient moves throughout the hospital. The other components of computer system 10 permit real time monitoring and data entry as discussed above.

Fig. 42 illustrates another embodiment of a physiological monitor signal junction box and transmitter of the present invention. In the illustrated embodiment, monitoring module 660 includes a housing 662 which is coupled to the patient 664 by strap 666. It is understood that the housing 662 may be coupled to other portions of the patient 664 by any suitable structure. In addition, the module 660 may be coupled to the patient support device 668 such as a bed or stretcher. A

module 660 may be also be coupled to a patient assist device, stand, or workstation as discussed above. Various physiological monitors such as heart rate monitors, temperature sensors, blood pressure cuffs, blood oxygen monitors, EKG monitors, and the like are coupled to the monitor by connector lines 670. Module 660 transmits signals from the physiological monitors via antenna 672 or other suitable wireless transmitter to the computer 12 or to a server 15 which receives the transmitted signals using a wireless receiver.

Illustratively, module 660 is similar to elements 32 in Fig. 2 and 82 in Fig. 4. Module 660 may include a separate battery that can be recharged when coupled to a computer module 50 or a wall outlet.

Yet another embodiment of the present invention is illustrated in Fig. 43. In this embodiment a computer module 680 is configured to be coupled to the patient support apparatus 668 to a patient assist 260 or other device as discussed above. Numerous coupling mechanisms described herein may be used to connect the computer module 680 to the bed or patient support 668, to the patient assist 260, or to one of the carts or workstations. In the Fig. 43 embodiment, computer module 680 includes the computer 12 and the components shown in Fig. 1 except for display 16. Computer module 680 includes a third display 682 in addition to display screens 18 and 20. In this embodiment, display screens 18 and 20 remain mounted to a wall 684 in a room by a mounting arm 686 or other support structure as shown in Fig. 43. Patient information and inputs are received on display screens 18 and 20 as discussed above. When in the room, computer 12 within module 680 is coupled to display screens 18 and 20 via a physical wired connection or via a wireless connection so that patient information is displayed on screens 18 and 20. However, when transported out of the room, display screen 682 is used.

Module 680 includes input connectors 688 coupled to physiological monitors 26, treatment devices 28, and therapy devices 30 by connecting lines 690 as discussed above. A wireless data transmitter 40 is provided to transmit signals from the monitors 26, treatment devices 28, and therapy devices 30 to the main server 15 when computer 12 is disconnected from the communication network 24. Therefore, computer 12 uses the larger display 16 which either includes an elongated single display, or side-by-side display screens 18 and 20 when the computer module 680 is

in the room. It is understood that the larger displays 16 may be located in different rooms throughout the hospital so that the computer module 680 can use the displays within each room for displaying patient information. Therefore, the large display 16 does not need to be transported with the patient through the hospital.

While the illustrated embodiments provide a computer at the point of care, including a computer which is designed to stay with the patient, another embodiment of the present invention includes a central computer, server or other processor configured to communicate through a wired or wireless connection to modules attached to the patient, a patient support such as a bed, table, stretcher, incubator, or the like. In other words, while computer 12 stays with each patient wherever he or she goes in the illustrated embodiments, it is understood that a single central computer or server in a room such as a neo-natal center may be used for many patients or infants with separate input devices and displays associated with each patient or infant.

Another embodiment of the present invention is illustrated in Fig. 44. Fig. 44 is illustrative display screen for displaying information related to patient vital signs such as heart rate, respiratory rate, fluid/electrolytes/nutrition, temperature, and neurological monitoring. Various sections of the star shown in Fig. 44 can be adjusted in color, size, or other manners to provide a visual indication to the caregiver of alarms or warnings in connection with one of the monitored vital signs. In addition to the visual indicator, displays of actual values of each of the measured parameters may be displayed on the display screen. As discussed above, these monitored items can be stored in the memory of the computer or transmitted to a main server at a remote location. The signals are then charted on a time basis. Treatments are also either manually or automatically recorded on a time basis so that a caregiver can assess the effectiveness of various treatments, request additional treatments or lab work, or intervene to take corrective actions. Showing that a particular treatment or therapy was effective to improve a patient condition or to prevent a subsequent condition from occurring may improve the ability to charge and collect for the treatment or be reimbursed for the treatments or therapies performed on the patient.

The present invention comprises one or more of the following features or combinations thereof.

1. A computer system or a component thereof assigned to a patient or to a bed or other device upon which the patient rests or with which the patient is associated, the system comprising a computer, a plurality of devices for sensing various physical conditions and characteristics of the patient, each device having an output coupled to the computer, and a display arranged to present the condition and status of the patient.

2. Such a system comprising a plurality of input devices for inputting data and instructions concerning the patient.

3. Such a system configured to store and retrieve data concerning the patient and the sensing devices and to display such data over a period of time to show relationships on a time basis.

4. Such a system comprising a memory in which the patient's history is stored for retrieval and display.

5. Such a system in which the sensing devices include heart rate sensors, respiratory rate sensors, neurological monitoring sensors, temperature sensors and the like.

6. Such a system comprising means for inputting fluid, electrolyte and nutrition data into the memory on a time basis.

7. Such a system comprising a communication network providing for remote monitoring of patient data and remote inputting of data and instructions.

8. Such a system further comprising a video imaging input to the computer to provide images of the patient.

9. Such a system further comprising ultrasound image input to the computer.

10. Such a system further comprising an x-ray image input to the computer.

11. Such a system in which the patient status and condition is stored and used for a time-based presentation on the display.

Figs. 45 and 46 illustrate a portable or movable workstation 710 having a base 712, a top vertical support member 714, a bottom vertical support member 715, and an upper support 716 coupled to top vertical support 714. A plurality of storage

containers 718 are also coupled to the top vertical support 714 below upper support 716. Upper support 716 includes a base frame 720 coupled to top vertical support 714. A keyboard 722 is movably and coupled to base frame 720 by tracks 724 so that keyboard 722 is movable from a retracted position shown in Fig. 45 to an extended position shown in Fig. 46. A release mechanism 726 for keyboard 722 is illustrated in Fig. 45.

A top surface 728 is movably coupled to base frame 720 by tracks 730. Top surface 728 is movable from a retracted position shown in Fig. 45 to an extended position relative to base frame 720 as shown in Fig. 46. Therefore, after the work station 710 is rolled into a room, the caregiver can extend the keyboard 722 and top surface 728 to provide a workstation for entering or reviewing patient data. The height of center vertical support 714, 715 is adjustable so that the caregiver can input data on the keyboard 722 in either a standing position as shown in Fig. 45 or seated position as shown in Fig. 46.

The patient computer system 732 is illustratively coupled to top surface 728. As discussed above, computer system 732 includes first and second displays 734 and 736 for displaying flow sheets or other information relating to the patient. Physiological monitors such as, for example, blood pressure cuffs and temperature probes are integrated into the computer system 732. The monitors may also be separate devices.

Figs. 47A, 47B and 48 illustrate details of illustrative types of information displayed on display 734 and 736. Illustratively, information in Fig. 47A is displayed on screen 734 and information in Fig. 47B is displayed on screen 736. Region 740 of Fig. 47B facilitates data entry of a head-to-toe physical assessment of the patient by selecting various regions on the patient icon. The caregiver may display or input different types of information related to the patient using the icon and entry keys. The "roll-in" workstation 710 moved with the patient to provide a dedicated computer at the point of care of the patient.

Another embodiment of the present invention is illustrated in Figs. 49-54. The patient assist cart 740 includes base 742 housing side supports 744 and 746 and elongated plates 748 and 750 coupled to the side supports 744 and 746, respectively. 752 are coupled to one end of plates 748 and 750. Casters 752 includes

self contained foot actuated locks. Locking 754 are coupled to the opposite end of plates 748 and 750. As described below casters 754 include a central brake mechanism.

The plates 748 and 750 extend past ends of side supports 744 and 746, respectively, to provide flexible leaf springs for coupling to the casters 752 and 754. In other words, the plates 748 and 750 may flex slightly during movement of the cart 740 over uneven surfaces. The patient assist cart 740 includes extending support tubes 756 and 758 coupled to a central portion 745 of base 742. Patient assist cart 740 further includes castor brakes mechanisms 760, a foldable seat 762, and movable handles 764 as discussed in detail below. A tank support bracket 766 is mounted to central portion 745 of base 742 for supporting an oxygen or air tank 768. A plurality of IV poles 770 are coupled to support tubes 756 and 758. A computer 772 including a plurality of vital signs monitor input ports is coupled to a central mounting portion 774 of cart 740. Illustratively, the mounting portion 774 extends between support tubes 756 and 758. Computer 772 is rotatable on cart 740 about an axis 776.

Fig. 50 illustrates a central aperture 778 formed in mounting portion 774. In the illustrated embodiments, batteries 780 are located inside side supports 744 and 746 to provide power to devices on the cart 740. An isolation transformer 782 and a battery charger 784 are also located within compartments in the base 742 as shown in Fig. 50. Cart 740 may be coupled to a wall outlet in a room when available by a plug (not shown). Batteries 780 are coupled to an electrical connector 786 aligned with aperture 778 to couple the computer 772 electrically to the patient assist cart 740. Computer 772 includes a male connector 788 configured to mate with female connector 786 on cart 740. Illustratively, power connector 788 provides 24 VDC power supply to the computer 772. A transceiver 790 is coupled to computer 772. Illustratively, the transceiver 790 sends and receives an IR or RF signal to communicate with devices or a network as discussed above. A connector 792 is provided for powering a dual display discussed above. Computer 772 includes a display screen 794. In addition, computer 772 includes a plurality of input connectors 796 for coupling monitors such as temperature monitors, blood pressure monitors, SPO2 monitors, ECG monitors, or other monitors to the computer 772 as discussed above. Physiological monitors or other devices are coupled to computer 772 as

discussed above or by wires or by a wireless connection to the computer 772 or to an interface connector so that the patient's vital signs are other characteristics continue to be monitored on real time basis when the patient is away from the hospital bed or patient room.

Patient assist apparatus 740 preserves floor space in the hospital room, is located at an ergonomic position and manages all the devices in one location. The computer 772 follows the patient to permit automatic data capture and the ability to access or enter patient data regardless of the patient location. Patient assist 740 provides a patient egress device, a transport device, and an in-room assist device. In another embodiment of the present invention a commode (not shown) is coupled to base 742. This eliminates the need for a separate bedside commode within the room.

Figs. 53 and 54 illustrate the patient assist cart 740 with another embodiment of computer 800 coupled to the support posts 756 and 758. In this embodiment, the display screen 802 is mounted to a first movable arm 804. Movable arm 804 is coupled to a pivotable arm 806 which is coupled to support tube 758. The embodiment of Figs. 53 and 54 provides greater visibility for a patient using the patient assist cart 740 as a walker or for a caregiver when using the patient assist cart 740 to push a hospital bed as shown in Fig. 69 below.

The computer 800 is illustrated in more detail in Figs. 55 and 56. The computer 800 includes a housing 808 having end portions 810 and 812 configured to be coupled to support tubes 756 and 758, respectively. In embodiment, the computer 800 is not easily removable from cart 740. Computer 800 includes a plurality of inputs 814 for vital signs monitors as discussed above. Illustratively, the vitals monitor is available from Nasiff Associates, Inc. located in Brewerton, New York. It is understood that other types of suitable monitoring modules may be used with computer 800. A plurality of RS 232 ports 816 are configured to receive connectors 818. Computer 800 also includes a USB ports 820 and a printer/mouse port 822. Computer 800 further includes a plurality of AC power receptacles 824, a speaker 826, a hard drive 828, and power converters 830 as shown in Fig. 56. In addition, computer 800 may include at least one PCMCIA card slot, a radio LAN device, and wireless Internet device. Computer 800 is coupled to display screen 802 includes a housing 832 mounted to arm 804 as discussed below.

Figs. 57 and 58 illustrate another embodiment of the present invention in which a display 834 and input device 836 are coupled to the support arm 804 and to computer 800. In addition, Figs. 57 and 58 show IV pumps 838 and IV bags 840 coupled to IV poles 770. A chest drainage apparatus 842 is also coupled to support tube 758.

Fig. 58 illustrates the arm 804 in a downwardly pivoted position and the display 834 pivoted relative to the arm 804 to facilitate use in the lower position. Arm 804 is rotatably coupled to arm 806 of cart 740 by pivot connection 844 so that the arm 804 rotates about axis 846. Arm 806 also rotatable about an axis extending through support tube 758. Therefore, the display 834 and input device 836 are positionable in a plurality of different orientations to facilitate use of the input device 836 and the display screen 834.

Further details of the seat 762 for supporting a patient are illustrated in Figs. 59 and 60. The seat is movable from an upwardly pivoted support position shown in Fig. 53 to a downwardly pivoted storage position shown in Fig. 54. As shown in Figs. 59 and 60, a mounting member 850 includes apertures 852 and 854 configured to receive support tubes 758 and 756 of cart 740 as shown, for example, in Fig. 49. Mounting member 850 is pivotably coupled to a planar seat 856 by pivot connections 858. Therefore, the seat 858 pivots relative to the mounting member 850 between the upwardly pivoted position shown in Fig. 53 to the downwardly pivoted position shown in Fig. 54. A seat support 860 is coupled to seat 856 by spaced apart couplers 862. End portions 864 of support 860 extend into the couplers 862 so that support 860 is pivotable about axis 866 relative to seat 856. Couplers include notched sections 868 configured to receive opposite side portions 870 support 860 to hold the support 860 in the position shown in Fig. 60. Couplers 862 include a ramp surface 872 to facilitate movement of the support 860 from the position shown in Fig. 60 to the position shown in Figs. 54 and 59. Side portions 870 move outwardly as shown in Fig. 59 as the support is pivoted in the direction of arrow 882. Support 860 is shaped to provide spaced apart support legs 874 and 876 which are configured to engage plates 748 and 750 as shown in Fig. 53 to support the seat 856.

When it is desired to use the seat 762, an operator pivots the seat 856 upwardly about mounting member 850 in the direction of arrow 878 in Fig. 54. As

the seat 856 is lifted, support 860 pivots downwardly about axis 866 in the direction of arrow 880 in Fig. 59 until the side portions 870 enter notches 868 formed in couplers 862 to hold the support 860 in the position shown in Fig. 60. Therefore, the support 860 automatically pivots downwardly and is maintained in the support position by couplers 860 when the seat 856 is pivoted upwardly.

When it is desired to move the seat 862 to a storage position, the user first pivots the support 860 about axis 866 in the direction of arrow 882 shown in Figs. 53 and 60. Support 860 pivots to be generally co-planar with seat 856 as shown in Fig. 54. Seat 856 holds the support 860 in the position shown in Fig. 54 for storage.

Figs. 53 and 54 also illustrate the handle assembly 764. When in the orientation shown in Fig. 53, a patient may use the handles 884 and 886 for support or like a walker. A center bar 887 extends between handles 884 and 886. Handle assembly 764 is coupled to cart 740 by coupling mechanisms 890 best shown in Figs. 61, 63 and 64. Handles 884 and 886 are pivotable by an axis 891 in the direction of arrow 888 in Fig. 53 to lie on an opposite side of support tubes 56 and 58 as shown in Fig. 54. In the Fig. 54 orientation, the handles 884 and 886 are usable by a caregiver to push a bed, wheelchair or other device attached to the patient assist cart 740.

As shown in Figs. 61 and 62, the center rod 887 includes a cylindrical body portion having a flat sections 892 adjacent opposite ends. End couplers 894 are coupled to bar 887. Each coupler 894 includes an aperture 896 configured to receive an end of a handle 884, 886. A stop 898 is located on each coupler 894. As best shown in Figs. 63 and 64, mounting mechanisms 890 include an aperture 900 formed to receive support tubes 756 or 758. When the handles 884 and 886 are pivoted upwardly as shown in Fig. 63, the flat sections 892 on center bar 887 are aligned with an opening 902 formed in coupling mechanism 890. A Belville washer 904 and a friction member 906 are located within the opening 902. An inner surface of friction member 906 illustratively has a cylindrical shape to engage an outer surface support tube 756 or 758. When the flat section 892 is aligned with opening 902 as shown in Fig. 63, the mounting mechanisms 890 can slide up and down on support tubes 756 and 758 in the direction of double headed arrows 908 in Fig. 53. Fig. 54 shows the

handle assembly 764 moved downwardly. Handles 884 and 896 provide arm rests for the seat 856 in this orientation.

When the handles 884 and 886 are pivoted downwardly in the direction of arrow 910 in Fig. 64, center bar 887 rotates in the direction of arrow 912 which causes an outer cylindrical portion of bar 887 to engage Belville washer, thereby compressing the Belville washer and moving the friction member 906 into engagement with an outer surface of tubes 756 and 758. Therefore, the handle assembly 764 is held in position on support tubes 756 and 758.

When the patient assist cart 740 is used to push a hospital bed or wheelchair, the handles 884 and 886 are rotated beyond the support tubes to the position shown in Fig. 54. The cylindrical surface of center bar 887 also compresses the Belville washer 904 and moves the friction member 906 against posts 756, 758 when in the Fig. 54 orientation. A shuttle lock 916 on each mounting mechanism 890 is pressed inwardly to move the shuttle member 916 into alignment with stops 898 on couplers 894 to lock the handles in the position shown in Fig. 54. Shuttle member 916 is moved in an opposite direction when it is desired to pivot the handles back to the position shown in Fig. 53.

Fig. 65 illustrates a caster braking mechanism 760 of one embodiment of the present invention. Support tubes 756 and 758 are each illustratively mounted over an inner tube 920. Support tubes 756 and 758 are biased upwardly in the direction of arrow 922 by a spring 924. A coupler 926 is coupled to each support tube 756, 758. Coupler 926 includes spaced apart arms 928 and 930. Casters 754 are rotatably coupled to plates 748 and 750 for rotation about axis 932. Casters 754 include a stem 934 having a rotatable brake actuator 936 configured to actuate an internal brake 938 when the actuator 936 is rotated about its longitudinal axis 940. Illustrative, casters 754 are model number 2944 casters available from Tente, although any suitable caster may be used. An arm 942 has a first end pivotably coupled to coupler 926 by a pin 944 extending between arms 928 and 930. On opposite end of arm 942 includes an elongated slot 946 located over actuator 936. Illustratively, the slot is sized so that opposite side walls engage opposite sides of hex shaped actuator 936. When user uses patient assist cart 740 as a walker and pushes down on handles 884 and 886 with enough force, support tubes 756 and 758 are forced downwardly in

the direction of arrow 948 by the patient's weight. Similarly, when the user sits on seat 762, the user's weight moves support tubes 756 and 758 downwardly in the direction of arrow 948. Couplers 926 also move downwardly causing arm 942 to pivot about axis 940, thereby rotating actuator 936 and braking the castor 754.

In another embodiment of the present invention, the support tubes 756 and 758 are mounted directly over a tube on the casters and spring biased upwardly. Therefore, application of weight to the support tubes cause a brake coupled to the support tubes to engage the casters.

Figs. 66-68 illustrate details of the mounting arm 804 shown in Figs. 53, 54, 57, and 58. Arm 804 includes a head 950 having a flat surface 952 configured to be secured to the display screen 802, 834. Head 950 includes outer walls 954 and 956 and a central portion 958 defining slots 960 and 962. A base 964 is pivotably coupled to the patient assist cart 740 by connector 966. Base 964 includes first and second spaced apart side walls 968 and 970 and a central portion 972 defining first and second slots 974 and 976. A bottom linkage 978 includes spaced apart arms 980 and 982 coupled together by a plate 984 as best shown in Fig. 68. Arm 980 is coupled between side wall 954 and side wall 968 as shown in Fig. 66. Arm 982 is coupled between side wall 956 and side wall 970 by suitable fasteners. Arms 986 and 988 are also pivotably coupled between head 950 and base 964. Arm 986 has a first end located in slot 960 and a second end located in slot 974. Arm 988 has a first end located in slot 962 and a second end located in slot 976. A coupler 990 is secured to plate 984 by suitable fasteners 992 as shown in Fig. 67. A gas assist spring 994 includes a first end 996 pivotably coupled to coupler 990 and a second end 998 pivotably coupled between the top arms 986 and 988 by pin 1000. A cover 1002 is located over the arm components. Base 966 includes a top plate 1004. As shown in Fig. 67, base 964 is secured to plate 1004 by fasteners 1006. As the arm 804 is pivoted from a generally vertical position as shown in Fig. 57 to a generally horizontal position shown in Fig. 58, the mounting surface 952 rotates so that display 802, 834 is visible when the arm is either in arm 804 is in the vertical position and in the horizontal position.

As shown in Figs. 54 and 61, the patient assist cart 740 includes a pair of latching mechanisms 1010 which are illustratively formed integrally with the

mounting mechanisms 890 for handles 884 and 886. It is understood that the latch mechanisms 1010 may be separately formed. Each latching mechanism 1010 includes a support having first and second upper arms 1012 and 1014 and first and second spaced apart lower arms 1016 and 1018. A first latch portion 1020 pivotably coupled between arms 1012 and 1014 by pin 1022. A second latch portion 1024 is pivotably coupled between arms 1016 and 1018 by pin 1026.

Latches 1010 are configured to secure the patient assist cart 740 to a hospital bed 1030 as best shown in Fig. 69. Bed 1030 illustratively includes a base 1032 and a frame 1034 coupled to the base 1032. Illustratively, the frame includes a head frame member 1036. A pair of spaced apart brackets 1038 mounted to head frame member 1036. Brackets include a cross pin 1040 shown in Figs. 70-72 which is configured to enter the latch 1010. Initially, the upper and lower latch portions 1020 and 1024 are located in the orientation shown in Fig. 70. Upper latch 1020 includes an arm 1044 and bottom latch 1024 includes arms 1046 and 1048. Initially, latch members 1020 and 1024 are biased to the position shown in Fig. 70 by a spring 1050 as the patient assist cart moves toward the bed in the direction of arrow 1052, the pin 1040 engages arm 1044 of upper latch portion 1020 to pivot upper latch portion 1020 in the direction of arrow 1054. A distal end of arm 1044 moves along the curved surface 1056 extending between arms 1046 and 1048 of bottom latch portion 1024. This causes bottom latch portion 1024 to pivot in the direction of arrow 1058 until the end of arm 1044 moves to the position of Fig. 72 to secure the locking pin within the latch mechanism and hold the latch portions 1020 and 1024 in the locked position. An operator releases the latch mechanism by manually rotating the upper latch portions 1020 in the direction of arrow 1060 in Fig. 72. This permits spring 1050 to move the latch portions 1020 and 1024 back to the position shown in Fig. 70. Therefore, the patient assist cart 740 can be removed from the bed.

Fig. 73 illustrates a wheelchair 1062 coupled to the patient assist cart 740. Front wheels 1064 of wheelchair 1062 are illustratively supported off the ground and latched to the base 742 by latch members 1066. Therefore, a caregiver can push the wheelchair 1062 and the patient assist cart 740 in a normal manner using handles 1068 of wheelchair 1062. The patient assist cart 740 can also be coupled to a rear surface 1070 of wheelchair 1062 using locking pins similar to those discussed above.

In this embodiment, handles 884 and 886 are pivoted to the position shown in Fig. 54 and used to push the wheelchair 1062 and patient assist cart 740.

Figs. 74-76 illustrate another embodiment of a dual screen display 1100 of the present invention. Display 1100 includes a housing 1102 having a first housing portion 1104 coupled to a second housing portion 1106 to define an interior region therebetween. First and second display screens 1108 and 1110 are located within the interior region of housing 1102. As shown in Fig. 75, first housing portion 1104 includes an outer flange 1112 configured to engage an edge 1114 of second housing portion 1106. Illustratively, a gasket or other seal is provided to provide a waterproof seal for the housing for holding the first and second display screens 1108 and 1110. As shown in Fig. 75, power supplies 1116 and electric components 1118 for converting electrical signals for display screens 1108 and 1110 are located on first housing portion 1104. Second housing portion 1106 includes a mounting region 1120 configured to be coupled to the head 950 of arm assembly 804.

Details of the display 1100 coupled to arm 804 are shown in Fig. 77 and 78. Illustratively, arm 804 is coupled to a primary arm 1122 by a coupler 1124. Base 964 of arm 804 is pivotably coupled to coupler 1124 about axis 1126. Coupler 1124 is pivotably coupled to primary arm 1122 about axis 1128. On opposite end of primary arm 1122 is pivotably coupled to another coupler 1130 about pivot axis 1132. Coupler 1130 is pivotably coupled to a mounting bracket 1134 about a pivot axis 1136. The arms 1122 and 804 can therefore be moved to a plurality of different orientations in a room to facilitate viewing and data entry into the computer as discussed above. A protective frame 1138 is coupled to display 1104 to protect the display. The arms 804 and 1122 also move the display 1100 to an ergonomic position for entering data as shown in Fig. 81.

Another embodiment of a primary arm is illustrated in Figs. 79A-79C. Primary arm 1140 is coupled to secondary arm 804 to support a cantilevered load such as display 1100 as indicated at location 1142. Primary arm 1140 supports the bearing load at location 1144. Arm 1140 includes three separate linkage arms 1146, 1148 and 1150 which are grounded at locations 1152, 1154 and 1156, respectively. A rigid coupler 1158 is pivotably coupled to each arm 1146, 1148, 1150 by connections 1160, 1162 and 1164, respectively, that form a triangular pattern. Fig. 79A illustrates the

primary arm at a +70 degree angle. Fig. 79B illustrates the configuration of primary arm 1140 at a zero degree angle, and Fig. 79C illustrates the position of primary arm 1140 at a -70 degree angle. Primary arm 1140 is illustratively two four bar linkages which are out of phase by 90 degrees to achieve maximum stability. As shown in Fig. 79B, an extension spring 1166 is coupled to one of the linkage arms 1146, 1148, or 1150. Extension spring 1166 is similar to the spring shown in U.S. Patent No. 5,826,846, which is incorporated herein by reference.

When primary arm 1140 is at its uppermost angle (i.e. +70 degrees), little or no balance force is required to maintain the angular position of display 1100. At this position extension spring 1166 is in its natural unextended position and does not provide any counterbalance force to primary arm 1140. As primary arm 1140 rotates the amount of balance force necessary to hold display 1100 in a neutral position increases linearly with the angle of rotation. As the rotation occurs, spring 1166 extends and supplies a counterbalance force that also increases as spring 1166 extends. Thus, the necessary balance force required by display 1100 is offset by the extension force supplied by spring 1166.

Figs. 80-82 illustrate the patient assist cart 740 and the dual display 1100 located in a hospital room 1200. A patient 1202 is located on a bed 1204. The patient assist cart 740 is located adjacent a head end of bed 1204. Therefore, computer 800 on patient assist cart 740 continues to collect patient information while the patient is in room 1200. Computer 800 is configured to drive the dual display 1100 when the patient assist is in the room 1200. A cable 1206 extends from computer 800 to the display 1100. A head wall 1210 which is coupled to wall 1212. A light 1214 is coupled to wall 1212 above head wall 1210. In Fig. 80, the dual display 1100 and arms 804 and 1122 discussed above are moved to a configuration to position the dual display 1100 in a region 1216 located between the light 1214 and the head wall 1210. Display 1100 is very close to wall 1212 so that display 1100 is out of the way. In Fig. 80, arm 1122 extends generally parallel to wall 1212 and arm 804 extends upwardly from arm 1122.

Fig. 81 shows the arms 804 and 1122 moved downwardly to permit a caregiver 1218 to enter data into the computer using the display 1100 as discussed above. The height and angle of display 1100 facilitate use by caregiver 1218 for data

entry and viewing. The arm 804 is configured to pivot the display 1100 and align the display 1100 at an ergonomic angle of about 5 degrees to about 60 degrees relative to the ground for data entry and viewing. Preferably the angle is about 20 degrees to about 40 degrees. Fig. 82 illustrates the arms 804 and 822 moved to an elevated position so that the monitor may be viewed at a position above the head of caregiver 1218. In Fig. 82, the display 1100 is out of reach of children. The arms 1122 and 804 permit the display 1100 to be located at the plurality of different orientations.

Fig. 83 illustrates additional details of the computer 800 which drives display screens 1108 and 1110 on display 1100 and also drives display screen 802 on patient assist cart 740. Computer 800 illustratively includes two video cards 1230 and 1232. The first video card 1230 drives both the display screen 802 on patient assist cart 740 and the first display screen 1108 on display 1100. The second video cart 1232 drives the second display screen 1110 on display 1100. In other words, the images on display screen 802 and display screen 1108 are the same. This reduces the cost of computer 800.

Fig. 84 is a block diagram illustrating one embodiment of electronic circuitry for coupling the computer 800 located on a patient assist cart 740 or work station to a dual monitor display screen 1100 coupled to an arm 804, 1122 in the room. The computer 800 on the patient assist cart 740 includes a firewire link to the dual screen display 1100. Main computer 800 illustratively includes a mux-demux for video, touch screen, TCI/IP communications over the firewire connection. The remote display 1100 has mux-demux with a microcontroller for firewire protocol handling. It is understood that other types of transmission line systems may be used to couple computer 800 to display 1100. For instance, a Low Voltage Differential Signaling (LVDS) interface may be used to couple computer 800 to dual display screen 1100.

Fig. 85 is a block diagram illustrating an alternative embodiment of electronic circuitry for coupling computer 800 located on the patient assist cart 740 to the dual monitor display screen 1100. The Fig. 85 embodiment, computer 800 includes mux-demux for sending PCI bus signals over the fire wire connection. Display 1100 has mux-demux with a microcontroller to convert PCI bus signals back to parallel form. LVDS is also an alternative to the firewire in this configuration. Fig.

86 illustrates yet another embodiment of the electronic circuitry for coupling the computer 800 on the patient assist cart 740 to the dual monitor display screen 1110 on the support arm 804, 1122 within the hospital room 1200.

Although the invention has been described in detail with reference to certain illustrated embodiments, variations exist within the scope and spirit of the invention as described and as defined in the following claims.